

# DEALING WITH MULTILINGUALISM IN THE ARITHMETIC CLASS

## An Ethnographic Case Study of a Dutch Primary School

Jeff Bezemer

Tilburg University, The Netherlands

### Abstract

*This paper focuses on the ways in which a teacher at a Dutch primary school deals with multilingual school populations in everyday practice. An illustrative episode from an arithmetic lesson is discussed that was observed in a classroom of seven-year-old, first and second language learners of Dutch, in which they are taught to split up addends. The analysis points at the algorithmic problem solving strategy the teacher adopts, which structures the interaction into IRF-sequences and obscure problems of understanding. Among other factors, the subtle nuances of meaning conveyed through the teacher's language of instruction seem to have contributed to these problems of understanding.*

### 1. Introduction

Contemporary primary school populations in the Netherlands represent a wealth of languages, ethnicities and cultures. In 2001, 15.2 percent of all primary school pupils were registered as belonging to 'cultural minorities', which means that at least one of their parents was born in Turkey, Surinam, Morocco, the Antilles and Aruba, or another country from an exhaustive list of countries drawn up by the government, or that the parents are admitted refugees (Ministerie van OC&W 2002). Out of these 236,700 pupils, 86 percent has at least one parent who is low-educated. It is well-documented that throughout the curriculum, the average mathematics achievements of cultural minority pupils are significantly lower than the achievements of other pupils (Tesser & Iedema 2001). Apart from their low socio-economic status, one of the crucial explanations for these differences lies in the pupils' proficiency in the standard language of communication at schools (Myers & Milne 1988), to which they are not or less frequently exposed at home. The languages most often spoken at the homes of primary school pupils apart from or instead of Dutch include Turkish, Arabic, Berber, English, Hindustani, and Papiamentu (Extra *et al.* 2002).

In spite of the emergence of 'realistic mathematics education' in Dutch primary school textbooks (Janssen *et al.* 1999), which puts a high premium on language proficiency in having pupils rediscover mathematics through negotiating meanings of imaginable problems (Gravemeijer 1994), only a few Dutch case studies have focused particularly on the role of language in the multicultural *mathematics* classroom. The studies in which this perspective was adopted, reveal problems of understanding triggered by ambiguous or infrequent words being used (Prenger 2001), and functional clarifications of word meanings among pupils (Elbers & De Haan 2003). There are limited opportunities for content-based language learning through active participation and

negotiation of meaning in both whole-class and dyadic interaction with the secondary school teacher (Van Eerde *et al.* 2002; Elbers *et al.* 2002).

It is against this background that arithmetic lessons were analysed which took place in a multicultural primary school in the Netherlands. The study was part of an international research project that aims to shed light on the classroom interaction underlying language minority pupils' participation and performance.<sup>1</sup> Adopting an ethnographic, empirical-interpretive perspective (Kroon & Sturm 2000), data were collected at the fourth form of the multicultural primary school 'De Rietschans'<sup>2</sup> in the Netherlands in the school year 1999/2000. The fourth form of De Rietschans had 25 pupils, of which 14 said that Dutch was their sole home language. The other pupils spoke Turkish (7 pupils), or Moroccan-Arabic and/or Berber (4) at home apart from or instead of Dutch. Neither of the pupils had been educated before in another country. More than 60 per cent of the pupils, including all multilingual pupils, had low-educated parents. The average age of the pupils was seven years. 'Mister Ed', the form teacher, was born in 1940 and had worked at the monocultural predecessor of De Rietschans for 26 years before it amalgamated with a multicultural school into De Rietschans 10 years ago.

The data consist of field notes, audio recordings, interview transcripts, and school documents. Over 55 hours of classroom interaction in the fourth grade were observed and audio taped. Once a particular mathematics lesson caught the eye of the observer because of abundant misunderstandings, an analysis was drawn with respect to the pedagogical content, the way in which this content was presented to the pupils, the structure of the interaction in which the content was embedded, and the sources of the problems of understanding that were unveiled. These outcomes were discussed with the teacher. The exercises from the math textbook which appear in this lesson are introduced in Section 2. In Section 3, an illustrative episode from the lesson is presented. Section 4-6 are devoted to the algorithm that underpins the teacher's methodology, the problems of understanding arising in the lesson and the ways in which these problems of understanding can be understood.

## 2. A mathematics textbook

For several years, teacher Ed has used the textbook *Rekenen en Wiskunde* (Van Galen *et al.* 1984a,b), which literally means 'Arithmetic and Mathematics'. The textbook, a representative of the realistic approach (De Jong 1986), was designed with a view to teaching socially disadvantaged pupils (Van Galen *et al.* 1984b:11), which was the reason why it was introduced at De Rietschans (Ed vi:27).<sup>3</sup> During the main week of observation, which covers 23 hours, the Rietschans' fourth grade was working on arithmetic for approximately 5.75 hours.

Having followed the script suggested in the teacher guide to *Rekenen en wiskunde*, Ed devoted most of these 5.75 hours to preparatory activities for learning to add and subtract beyond ten, with which the class had already started before the observation week (teacher's log). These preparatory activities, which take nine lessons in the script,

aim at the ability to conjoin and split up operations. In order to be able to add up, e.g., 13 and 8, the pupils are taught that ‘+ 8’ can be partitioned into ‘+ 7’ and ‘+ 1’. In the first lesson, pupils put numbers in an imaginary little machine that performs an operation. In the second lesson, pupils put numbers in a machine as well, yet the outcome is put in another machine. Then the input and output of these sequences of operations is compared to find out that in every instance, the same number is added. In the third lesson, the pupils replace two machines by one by adding up the addends they represent, understanding that this is more efficient. The fifth and sixth lesson also contain exercises to practise replacing two addends by one, but now the machines are left aside, and the problems are written in the pupils’ notebooks in conventional mathematical symbols.

In the seventh lesson, problems are practised in which the addend replacing two others is given, while one of the two addends to be replaced is missing, as in:

$$\begin{array}{r} 5 + 3 + \dots \\ 5 + 4 = \end{array}$$

Evidently, this requires partitioning or taking away rather than adding up addends. In the textbook, the problem is introduced with the lines: “What should be written above the line? + 1, because + 4 is the same as first + 3 and then still + 1” (Van Galen *et al.* 1984a:42). The lesson comprises 24 such sums. In the teacher guide, it is explained that in this lesson

“The aim is to calculate the missing operation (above the line). This is supposed to be done by splitting the operation below the line (+ 4), whereby the first part of the splitting is known ( $4 = 3 + \dots$ ). By subsequently calculating the sum in two ways the correctness of the splitting is checked:

$$5 + 3 = 8 \quad 8 + 1 = 9 \quad \text{and} \quad 5 + 4 = 9” \text{ (Van Galen } et al. \text{ 1984b:157).}$$

### 3. A mathematics lesson

It is Friday morning, 9.35 am, when Bétul, Nasira, Bouchra, Faïna, Joey, Dennis, Vincent, Sharona, Arzu and Feride have gathered together in the middle of the fourth grade classroom. About forty minutes ago, the teacher introduced the mathematical problem from the seventh lesson of math textbook to the whole class. Earlier this week, they made lesson 6 from the textbook, while the lessons 1-5 were dealt with before the autumn holidays (teacher’s log). After having treated twelve problems from today’s lesson, he asks who hasn’t understand the problem yet. Those who indicate they do not, form the group in the middle of the classroom, solving such problems under the supervision of the teacher. The other pupils make these problems on their own. The fourth problem treated in the middle group reads:

$$\begin{array}{r} 8 + 1 + \dots \\ 8 + 2 = \end{array}$$

The episode in which this problem is being discussed, reads as follows.<sup>4</sup>

- Teacher: Let's move to the last sum. The last sum. Off we go again. Eight/. What do I write down Nasira?
- Nasira: Eight add-up<sup>5</sup> one.
- Teacher: Add-up one add-up. Eight and one and. But I shouldn't add ;one, I should?
- Nasira: Eight add-up two.
- Teacher: There should be?
- Nasira: Eight add-up two.
- Teacher: There should be two added to that. So I shouldn't add t/ one, but two. How many ;did I already add? Betul?
- Bétul: Two.
- Ed: Does it say in yours: eight plus two? What does it say in yours then? In the/ in your notebook?
- Bétul: +.
- Teacher: Now what did you write down?
- {Bouchra}: Hh, yes!
- Teacher: What did you write down?
- Bouchra: Plus seven.
- Teacher: What?
- Bouchra: Plus seven.
- Teacher: Plus seven. (raises voice:) ((Just ;two need to be added. And then you say: plus seven.)) Just two need to be added. And how many did you already add? What did you write down? Eight plus?
- Bouchra: Eight plus one plus/.
- Teacher: Stop. Eight plus one. So I already added one. And there ;had to be added two. How many do I still have to add now?
- {Bouchra}: Two.
- Teacher: Listen. Look, look, look. There have to be added two. Yes? Just look in the book. Eight plus two. I ;have already done: eight plus ;one. How many do I still have to add now?
- {Bouchra}: One.
- Teacher: Now still one to add. So what sum do I get? Eight plus one plus?
- {Bouchra}: Eight plus one plus one.
- Teacher: One.
- Teacher: Eight plus one plus one (taps on table). And then I have result?

{Faïna} Ten.

Teacher: Ten.

#### 4. An algorithm

Arguably, in this episode, it is the teacher who asks questions, it are the pupils who, if nominated by the teacher, reply, and it is the teacher again who evaluates these replies in ‘elicit exchanges’ composed of initiation, response, and feedback elements (Sinclair & Coulthard 1975). There are six questions along which the teacher tries to lead the children through the process of solving a problem, each of which are intended to elicit a specific number or operation that is either given or the outcome of calculation. These are:

1. What do I write down?
2. But I shouldn’t add one, I should?
3. How many did I already add?
4. How many do I still have to add now?
5. So what sum do I get?
6. And then I have outcome?

The pupils’ replies to (rephrasings of) these questions do not contain anything but numerals and operators. They merely literally verbalise mathematical symbols, without getting the opportunity to make explicit their constructions, let alone to negotiate mathematical meanings. The teacher’s evaluation of the pupils’ replies to these questions is not put across in terms of ‘right’ or ‘wrong’, but instead takes the form of a declarative or a (repetition or rephrasing of a) question.

Altogether these questions aimed at particular numbers and operations constitute an algorithm that is supposed to generate the solution to the problems. Or, as Sinclair & Coulthard (1975:51) put it, the teacher uses “a series of elicit exchanges to move the class step by step to a conclusion”. This structure illustrates the dominant pattern of interaction throughout the arithmetic lesson. In four instances of the whole lesson, pupils vainly try to get the floor by addressing the teacher, perhaps to request clarification. It is only once that a pupil is invited to explain how she arrived at her solution to the problem at hand. However, also in that case it is the teacher who evaluates the pupil’s contribution, thus finishing off the exchange of meanings.

#### 5. Problems of understanding

Noticeably, the algorithm does not automatically lead to a smooth flow of the interaction. Especially the third and fourth question (‘How many did I already add’; ‘How many do I still have to add now?’), in which Bétul and Bouchra are involved, raises serious problems. This exemplifies what is happening throughout the lesson. In total, Ed poses 78 questions to children to guide them through the problem at hand. In 28 instances, the pupil’s answer does not seem to satisfy the teacher, excluding the answers that contain more information than the specific number requested which he does not turn down explicitly (in case he repeats his question after such an answer, as

in the episode presented, the instance was included). In two cases, it seems that the teacher misheard the pupil's answer, resulting in rephrasings of the question and the pupil, thinking that his first answer was wrong, giving incorrect answers. Leaving out these instances, 23 questions (29 percent) were answered incorrectly while dealing with these problems. Fifteen of those were given by Nasira, Bétul and Bouchra (of which seven times in the key incident). In eight out of the 23 questions, the teacher asked for the 'number that was already added', and in seven cases for 'the number that still has to be added'.

The sources of the problems the pupils have in answering the third and fourth question are not surfaced in the interaction. The pupils do not make explicit the difficulties they encounter, while the teacher does not inquire the difficulties either. In three instances of the math lesson, the teacher does inquire their understanding. However, these comprehension checks appear to serve primarily to determine how many pupils believe they understand the problems, while the exact difficulties the pupil experience who do not understand the problems remain concealed. Only on one such occasion a pupil is asked to make explicit what it is she does not understand, yet she is unable to do so. After all, the identification of the exact difficulty one experiences in performing a mathematical task requires a certain degree of meta-cognitive skills, while the communication of that difficulty requires a certain mastery over the language of mathematics. In addition, the interactional structure the teacher adheres to, leaves no room for the pupils to request clarification.

## 6. Understanding problems of understanding

A combination of intertwined factors will have complicated the understanding of the mathematical reasoning involved in answering the teacher's questions. When it comes to the pupils, it should be noted that the pupils engaged in the event underachieve on both math and vocabulary tests, so that new mathematical insights will not be gained effortlessly. An arithmetic test from the national testing institute (Janssen *et al.* 1992) indicates that, in comparison to a national sample, Bétul and Nasira belong to the 25 percent lowest scoring pupils, while Faïna and Bouchra scored right below the national average. As regards vocabulary, a test from the national testing institute (Verhoeven 1992) indicates that, in comparison to a national sample, they all belong to the 25 percent lowest scoring pupils.

When it comes to the teachers' didactics, a number of factors may have complicated the pupils' understanding. First of all, the transcript shows that the teacher does not make explicit the actual calculation that yields the correct answer, that is, ' $2 = 1 + .$ '. Although the pupils are reminded of this kind of problems in the very beginning of the lesson, the teacher does not link it up with the kind of problems they deal with today. Bouchra perhaps did remember this calculation from the beginning of the lesson, applying it such that the equation above the line, i.e., 'what she wrote in her notebook' was rendered into ' $8 = 1 + \dots$ '. Secondly, contrary to what the textbook suggests, the splittings are not checked by calculating both the sum of the addends above and below the line. Instead, only the equation above the line is calculated, while the equation

below is not even copied in the notebook. Also the meaning of the line remains unattended. Consequently, rather than foregrounding the act of partitioning, which is the aim of this exercise, the teacher's problem solving procedure focuses on finding the outcome of the sum. Finding the missing addend is treated as a necessary intermediary step in this procedure, while it was the intention of the textbook to consider the calculations of the outcome as a means to check the correctness of the partitioning.

The third factor complicating the understanding of the mathematical reasoning has to do with a particular feature of the teacher's language of instruction. When revisiting the transcript, it becomes clear that when asking questions and commenting on pupils' answers, the teacher translates the symbolic language in which the problem is stated in the book into natural, technical language. Since this variety of the standard language specifically serves the domain of school math, it can be taken as a 'mathematical register', which has distinctive linguistic features to convey mathematical meanings (Halliday 1978). In the event, this register comprises quotations from the book, whereby words are directly mapped onto mathematical symbols ("Eight plus two"; "Eight plus?"), and paraphrases of the problem, whereby more or less complete utterances are used to verbalise (aspects of) the problem ("Now still one to add.").

In both the interrogative and declarative paraphrases described above, the operations in the given problem are conceived of as actions anchored in a time span. While the operation below the line (+2) is usually phrased in present tense without reference to a particular time, the teacher once uses past tense in reminding the pupils of what was said before about this operation. The given operation above the line (+1) is considered as an action that took place in the past as soon as it has been copied in the notebook, which is expressed through present perfect tense marking<sup>6</sup> and the temporal adverbial *al* (already). The missing operation is considered to be the action that has to be performed at the moment of speaking. This is indicated by present tense and the adverbials *nou* (now) and *nog* (still). The correspondence between different anchoring in time and the different addends in the problem is summarized in Table 1.

<i>addend</i>	<i>tense marking</i>	<i>example</i>
+ 1 (given)	present perfect + <i>al</i>	<i>ik heb er al één bijgedaan</i> I already added one.
+ 2 (given)	simple present	<i>er moeten er twee bij</i> there should be two added to that
	simple past	<i>d'r moesten er twee bij</i> there had to be added two
+ 1 (missing)	simple present + <i>nou nog</i>	<i>hoeveel moet ik er nou nog bijdoen?</i> how many do I still have to add now?

Table 1: Time anchoring of addends in the teacher's instructions

In referring to different symbolic configurations, the teacher further distinguishes between the equation above and below the line by contrasting the documents where the equations can be found. Hence, the symbolic configuration  $8 + 1 (+)$  is referred to as what is to be written or what was written down in the notebook, while  $8 + 2$  is taken to be retrievable from the textbook. Throughout the math lesson, the teacher is consistent in using this format of references to (configurations of) numbers and operations.

Thus, in order to distinguish between the addends the teacher asks for or comments upon in his questions and remarks, the pupils have to be able to understand the meaning of the differences in expressions of present and past, involving morphosyntactic (tense marking) and lexical temporal devices ('already', 'now still'), with which these numerals and operations are distinguished in the mathematical register of the teacher. If they have noticed that 'what is written in the book' always refers to the equation below the line, and that 'what was written in the notebook' always refers to the equation above the line (even though this is written in the book as well), these instructions may be of some help to the pupils in identifying the symbolic configuration he is referring to.

Misunderstanding these subtle differences may well have complicated Bétul's, Bouchra's, and other pupils' understanding of questions like 'How many did I already add?' and "How many do I still have to add now?", which they answered incorrectly in fifteen instances of the lesson. Not only did they have to understand these questions as intended, they also had to understand the preceding paraphrases of the problem, in which these subtle distinctions were made as well. Although there is no research indicating at which stage seven-year-old bilingual pupils acquire temporal devices receptively, Bos (1997) showed that in telling stories, her Moroccan/Dutch bilingual informants aged between 5 and 9 are less able than their monolingual peers to establish subtle temporal relations.

The covertness of this feature of the mathematical register as for example compared to difficult vocabulary items counteracts the teacher's awareness of the difficult nature of the feature, and thus his alertness to the problems of understanding that may arise from it. While in interviews the teacher postulates differences in first and second language learning pupils' 'feeling for language' and vocabulary, he does not connect this observation to his language of instruction. In his view, there is no need to deal with differences in language proficiency, "because they have a sufficient command to listen to and to hold a conversation." Thus, the teacher is not expecting pupils to have difficulty comprehending which symbolic configuration he is referring to. At the same time, the identification and glossing of such problems by the pupils themselves requires a level of meta-cognitive and linguistic abilities they may not have achieved. Besides, the teacher strictly adheres to the algorithm, to which pupils would have to break through to signal problems of understanding or to request clarification.

Other analyses of our ethnographic corpus yielded similar results. The teacher's preference for 'transmitting' knowledge in teacher-controlled interaction rather than 'co-constructing' it is also manifest in other instances of his practice (Bezemer & Kroon 2002). The discrepancy between acknowledging linguistic heterogeneity in his rhetoric and pursuing educational routines which do not seem to take into account the multilingual reality of the classroom was revealed before as well (Bezemer 2003). The 'practical knowledge' (Meijer 1999) underlying these routines is informed by 28 years of experience in teaching monolingual, middle-class pupils. Notwithstanding the emerging awareness of multilingualism in terms of 'feeling for language' on a rhetorical level, this experience seems to have created a 'monolingual habitus' (Gogolin 1994) which is still manifest in his everyday practice in a multilingual classroom.

## References

- Bezemer, J. (2003). 'Dealing with Multilingualism in a Dutch Primary School. An Ethnographic Study of the Practise of Teaching Spelling to First and Second Language Learners.' In: G. Walford (Ed.), *Investigating Education Policy through Ethnography*. Amsterdam etc.: Elsevier.
- Bos, P. (1997). *Development of bilingualism. A study of school-age Moroccan children in the Netherlands*. Tilburg: Tilburg University Press.
- De Jong, R.A. (1986), *Wiskobas in methoden*. Utrecht: Vakgroep Onderzoek Wiskundeonderwijs en Onderwijscomputercentrum, RU Utrecht.
- Elbers, E. & M. de Haan (2003). The construction of word meaning in a multicultural classroom: talk and collaboration during mathematics lessons. In: this volume.
- Elbers, E., M. Hajer, T. Koole, M. Jonkers & J. Prenger (2002). Leerzame tweegesprekken: individuele begeleiding in multiculturele klassen. *Pedagogiek* 2, 159-171.
- Extra, G., R. Aarts, T. van der Avoird, P. Broeder & K. Ya\_mur (2002). *De andere talen van Nederland thuis en op school*. Bussum: Coutinho.
- Gravemeijer, K.P.E. (1994). *Developing Realistic Mathematics Education*. Utrecht: Utrecht CD B Press
- Halliday, M.A.K. (1978). *Language as social semiotic: The social interpretation of language and meaning*. London: Edward Arnold.
- Janssen, J., J. Brokhove & J.M. Kraemer (1992). *Rekenen-Wiskunde 1*. Arnhem: Cito.
- Janssen, J., F. van der Schoot, B. Hemker & N. Verhelst (1999), *Balans van het Reken-Wiskundeonderwijs aan het einde van de basisschool 3. Uitkomsten van de derde peiling in 1997*. Arnhem: Cito.
- Kroon, S. & J. Sturm (2000). Comparative Case Study Research in Education. Methodological Issues in an Empirical-Interpretative Perspective. *Zeitschrift für Erziehungswissenschaft* 3-4, 1-19.

- Meijer, P.C. (1999), *Teacher's practical knowledge. Teaching reading comprehension in secondary education*. Unpublished doctoral dissertation, University of Leiden.
- Ministerie van Onderwijs, Cultuur en Wetenschappen (2002). *Primair Onderwijs in cijfers 1997-2001*. Brochure OCenW.
- Myers, D.E. & A.M. Milne (1988). 'Effects of Home Language and Primary Language on Mathematics Achievement: A Model and Results for Secondary Analysis.' In: R.R. Cocking & J.P. Mestre (Eds.), *Linguistic and Cultural Influences on Learning Mathematics*. Hillsdale: Lawrence Erlbaum (pp.259-293).
- Prenger, J. (2001). 'Vocabulairehindernissen bij wiskunde. *Toegepaste Taalwetenschap in Artikelen* 2, 53-67.
- Sinclair, J.McH. & R.M. Coulthard (1975). *Towards an Analysis of Discourse. The English used by teachers and pupils*. Oxford: Oxford University Press.
- Tesser, P.T.M. & J. Iedema (2001). *Rapportage Minderheden 2001. Deel I Vorderingen op school*. Den Haag: Sociaal Cultureel Planbureau.
- Van Eerde, D., M. Hajer, T. Koole & J. Prenger (2002). 'Betekenisconstructie in de wiskundeles. De samenhang tussen interactief wiskunde- en taalonderwijs. *Pedagogiek* 2, 134-147.
- Van Galen, F., K. Gravemeijer, J.-M. Kraemer, T. Meeuwisse & W. Vermeulen (1984). *Rekenen & Wiskunde* (a: textbook, b: teacher guide). Baarn: Bekadidact.
- Verhoeven, L. (1992). *Woordenschattoets 1*. Arnhem: Cito.

## Notes

1. The project was carried out by Babylon, Centre for Studies of the Multicultural Society, Tilburg University, The Netherlands, and the Institute of Psychology, University of Oslo, Norway. The project was financed by the Ministries of Education of both countries.
2. The names of the school, the city, and the teachers are fictional.
3. The long interview is referred to as 'Ed i', with the number following standing for the page number of the transcript. Likewise, 'Ed vi' refers to the retrospective interview about the arithmetic lesson, and 'Head teacher' to the interview with the head teacher. 'Teacher log' refers to the log the teacher kept on his own initiative, in which he wrote down the activities he planned to do and indicated if they were in fact done.
4. The transcription conventions include / for repairs, restarts or interruptions, ; for emphasised words, (...) for impressionistic description of prosodic features, holding for the utterance between double brackets, underlined utterances for simultaneous speech, and {...} for uncertain transcription. Translations are in italics.
5. *Erbij* (adverb) *doen* (verb) is equivalent to 'to add'. In early arithmetics lessons '+' is often verbalised as *erbij*, even though sentences like *acht erbij één* are ungrammatical. The dummy *er* refers to the number to which to add.
6. This is not visible from the English translation. In Dutch, the teacher used the construction *Dus ik heb er al één bijgedaan*, in which *bijgedaan* is the past participle with *heb* as auxiliary verb.